1 C Introduction

C is syntactically very similar to Java, but there are a few key differences of which to be wary:

- C is function oriented, not object oriented, so no objects for you.
- C does not automatically handle memory for you.
  - In the case of stack memory (things allocated in the “usual” way), a datum is garbage immediately after the function in which it was defined returns.
  - In the case of heap memory (things allocated with malloc and friends), data is freed only when the programmer explicitly frees it.
  - In any case, allocated memory always holds garbage until it is initialized.
- C uses pointers explicitly. *p tells us to use the value that p points to, rather than the value of p, and &x gives the address of x rather than the value of x.

There are other differences of which you should be aware, but this should be enough for you to get your feet wet.

2 At Least There Are Comments.

Write the following functions so that they perform according to the provided comment.

1. /* The first function you write in any language. * Prints the string "Hello World\n" to standard output. */
   void hello_world() {
   printf("Hello World\n");
   }

2. /* Divides and takes the floor of a value exterior to this function by 2^POW. * Does not use the division function. */
   void div(int *y, unsigned int pow) {
   *y = y[0] >> pow;
   }

3. /* For each bit position i in [0, sizeof(int)*8) calls hello_world i times *iff the ith bit of the value X points to is set. */
   void HI_HI_HI_HI(int *x) {
   int i = 0, j = 0, int_bits = sizeof(int) * 8;
   for (i = 0; i < int_bits; i++) {
   if ((x[0] >> i) & 1) {
   for (j = 0; j < i; j++) {
   hello_world();
   }
   }
   }
   }

4. /* Computes and returns the nth fibonacci number, using an iterative approach. */
   int fib_iter(unsigned int n) {
   int fib0 = 0, fib1 = 1, i, swap;
for (i = 0; i < n; i++) {
    swap = fib1;
    fib1 += fib0;
    fib0 = swap;
}
return fib0;

3 Uncommented Code? Yuck!

The following functions work correctly (note, this does not mean intelligently), but have no comments. Document the code to prevent it from causing further confusion.

1. /* Returns the sum of the first N elements in ARR. */
   int foo(int *arr, size_t n) {
       return n ? arr[0] + foo(arr + 1, n - 1) : 0;
   }

2. /* Returns -1 times the number of zeroes in the first N elements of ARR. */
   int bar(int *arr, size_t n) {
       int sum = 0, i;
       for (i = n; i > 0; i--) {
           sum += !arr[i - 1];
       }
       return ~sum + 1;
   }

3. /* Does nothing. */
   void baz(int x, int y) {
       x = x ^ y;
       y = x ^ y;
       x = x ^ y;
   }

4 Programming with Pointers

Write the following functions so that they perform according to the provided comment. Not all questions are guaranteed to be soluble.

1. /* Swaps the value of two ints outside of this function. */
   void swap(int *x, int *y) {
       int temp = *x;
       *x = *y;
       *y = temp;
   }

2. /* Increments the value of an int outside of this function by one. */
   void plus_plus(int *x) {
       x[0]++;
   }

3. /* Returns a buffer for N ints. */
   // Insoluble using provided machinery. Can of course be done using malloc.
   int* allocate_buffer(unsigned int size) {
       return malloc(sizeof(int) * size); //note that this is an unchecked malloc
4. /* Returns the number of bytes in a string. Does not use strlen. */
   int mysstrlen(char* str) {
      int count = 0;
      while(*str++) {
         count++;
      }
      return count;
   }

5. /* Returns the number of elements in an array ARR of ints. */
   // insoluble

5 Problem?

The following code segments may contain either logic or syntax errors. Find them.

1. /* Returns the sum of all the elements in SUMMANDS. */
   int sum(int* summands) {
      int sum = 0;
      for (int i = 0; i < sizeof(summands); i++) // i < n
         sum += *(summands + i);
      return sum;
   }

2. /* Increments all the letters in the string STRING, held in an array of length N.
   * Does not modify any other memory which has been previously allocated. */
   void increment(char* string, int n) {
      for (int i = 0; i < n; i++) // for (i = 0; string[i] != 0; i++)
         *(string + i)++; // string[i]++; or (*(string + i))++;
   }
   // consider the corner case of incrementing 0xff

3. /* Copies the string SRC to DST. */
   void copy(char* src, char* dst) {
      while (*dst++ = *src++);
   }

   /* Parses a numeric character, putting the result into the value of VALUE and returning
   * 1 if it was successful and 0 otherwise. */
   int parse_digit(char c, int * value) {
      if(c>='0' && c<='9') // { //
         *value = c-'0';
         return 1; // }
      return 0;
   }